AWS QC10:2017

Specification for Qualification and Certification of SENSE Level I—Entry Welders

American Welding Society®

AWS QC10:2017

Specification for Qualification and Certification of SENSE Level I—Entry Welders

Supersedes AWS QC10:2008

Prepared by the
American Welding Society (AWS) Education Committee—Task Group on SENSE Standards

Under the Direction of the
AWS Education Committee

Approved by the
AWS Board of Directors

Abstract

AWS QC10, *Specification for Qualification and Certification of SENSE Level I—Entry Welders*, is the specification that defines the requirements for trainees to receive an AWS SENSE training certificate for full or partial completion of the Level I—Entry Welder program. It also specifies the requirements for SENSE training organizations in order to submit trainees for a full or partial AWS training certificate and inclusion in the AWS SENSE Certificate Database. AWS QC10 is the governing specification for *A*WS EG2.0, *Guide for the Training of Welding Personnel: SENSE Level I—Entry Welders*.

American Welding Society®

ISBN: 978-0-87171-932-4

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Foreword

This foreword is not part of this standard but is included for informational purposes only.

The AWS Schools Excelling through National Skill Standards Education (SENSE) program began in 1993 with the award of a grant by the U.S. Department of Education to develop a series of voluntary standards to promote consistency and quality in welding education on a national basis. The development of these National Skill Standards involved a survey of the welding industry, skilled trades, and the welding education community, to arrive at a consensus on welder skills and competencies required by industry. The result of this survey was an occupational task analysis. This task analysis formed the basis for the development of the SENSE specifications and guidelines.

Currently, there are two levels of SENSE: Level I—Entry Welder and Level II—Advanced Welder. Both levels are designed to facilitate the implementation of a modular welder training program based on best practices.

The specifications and guidelines for SENSE Level I were revised in 2015, and SENSE Level II—Advanced Welder was modularized to facilitate implementation in a variety of welder training programs. Supplements were also developed to provide technique sheets and AWS standard welding procedure specifications (SWPSs) for SENSE workmanship and performance qualification tests. The supplements are based on AWS B2.0, *Standard Welding Procedure Specifications (SWPSs)*. In addition, AWS QC21, *Specification for AWS Accreditation of SENSE Welder Training Programs*, was added. The specifications, guidelines, and supplements for SENSE welder training and welder training program accreditation are:

AWS QC10, *Specification for Qualification and Certification of SENSE Level I—Entry Welders*
AWS EG2.0, *Guide for the Training of Welding Personnel: SENSE Level I—Entry Welders*
AWS EG2.0 Supplement, *Supplement SENSE Level I—Entry Welder Training Performance Testing Procedures*

AWS QC11, *Specification for Qualification and Certification of SENSE Level II—Advanced Welders*
AWS EG3.0, *Guide for the Training of Welding Personnel: SENSE Level II—Advanced Welders*
AWS EG3.0 Supplement, *Supplement SENSE Level II—Advanced Welder Training Performance Testing Procedures*

AWS QC21, *Specification for AWS Accreditation of SENSE Welder Training Programs*
AWS EG21, *Specification for the Qualification of SENSE Welder Training Programs*

This latest revision of AWS QC10, *Specification for Qualification and Certification of Level I—Entry Welders*, represents the AWS Education Committee's consensus on the requirements for trainees of SENSE training organizations to receive an AWS SENSE training certificate for full or partial completion of the Level I—Entry Welder program, and to be registered in the AWS SENSE Certificate Database.

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1. Scope

1.1 This specification establishes the minimum requirements for trainees to receive AWS SENSE training certificate for full or partial completion of the Level I—Entry Welder program. SENSE training organizations are free to exceed these minimum requirements.

1.2 This specification defines practical knowledge examinations, as well as the workmanship and performance qualification tests that require a minimum level of reading, computational and manipulative skills to successfully complete.

1.3 All individuals that meet the specified training certificate criteria will be listed in the AWS SENSE Certificate Database provided that:

(1) the training facility is a SENSE Accredited Training Program (ATP) per the requirements of AWS QC21, *Specification for AWS Accreditation of SENSE Welder Training Programs*

(2) the required proof(s) of completion are submitted to AWS along with applicable fees.

1.4 Organizations that are not a SENSE Accredited Training Program may use this specification, but individuals they instruct will not be eligible for SENSE training certificates, nor will they be listed in the AWS SENSE Certificate Database.

1.5 Although some questions on knowledge examinations may pertain to safety, this specification is not intended to address safety and health. Safety and health requirements are provided in ANSI Z49.1, *Safety in Welding, Cutting, and Allied Processes*, as well as federal, state, and local government regulations. The responsibility for safety rests primarily with the trainee and the training organization during training.

2. Reference Documents

Unless specified, the latest approved revision applies.

ANSI Z49.1, *Safety in Welding, Cutting, and Allied Processes*

AWS A3.0M/A3.0, *Standard Welding Terms and Definitions, Including Terms for Adhesive Bonding, Brazing, Soldering, Thermal Cutting, and Thermal Spraying*

AWS B2, *Standard Welding Procedure Specifications (SWPSs)*

AWS B2.1/B2.1M, *Specification for Welding Procedures and Performance Qualification*

AWS B4.0, *Standard Methods for Mechanical Testing of Welds*

AWS B5.5, *Specification for the Qualification of Welder Educators*

AWS C4.1, *Criteria for Describing Oxygen-Cut Surfaces, and Oxygen Cutting Surface Roughness Gauge*

AWS EG2.0, *Guide for the Training of Welding Personnel Level 1—Entry Welder*

AWS EG2.0 Supplement, *Supplement SENSE Level I—Welder Training Performance Testing Procedures*

AWS EG21, *Specification for the Qualification of SENSE Welder Training Programs*

AWS QC5, *Standard for AWS Certification of Welding Educators*

AWS QC21, *Specification for the AWS Accreditation of SENSE Welder Training Programs*

3. Definitions

The terms used in this specification are defined in AWS A3.0, *Standard Welding Terms and Definitions*. As used in this specification, the word **shall** denotes a requirement; the word **should** denotes a guideline; and the word **may** denotes a choice. The following terms are not found in AWS A3.0, or are modified for the purposes of this specification:

acceptance criteria. Specified limits placed on characteristics of an item, process or service as defined in governing welding standards or other contract documents.

Accredited Training Program (ATP). A facility that applies to the AWS and receives accreditation. An Accredited Training Program may be a school, college, technical institute, or other training organization that meets the requirements of AWS QC21, *Specification for AWS Accreditation of SENSE Welder Training Programs*.

AWS SENSE Certificate Database. A database of trained welders who have achieved full or partial completion status by successfully passing compulsory and optional modules in accordance with the requirements of SENSE Level I—Entry Welder, and SENSE Level II—Advanced Welder. Employers may access this database to confirm the welding education credentials of prospective employees.

AWS Certified Welder. A welder that meets the requirements of QC7 for welder performance qualification. AWS welder certification under QC7 should not be confused with AWS SENSE training certification.

AWS SENSE Advanced Welder. An individual who has achieved full or partial completion status by successfully completing compulsory and optional modules in accordance with the requirements of SENSE Level I—Entry Welder, and AWS SENSE Level II—Advanced Welder. AWS SENSE Advanced Welder should not be confused with AWS Certified Welder.

AWS SENSE Entry Welder. An individual who has achieved full or partial completion status by successfully completing compulsory and optional modules in accordance with the requirements of SENSE Level I—Entry Welder. AWS SENSE Entry Welder should not be confused with AWS Certified Welder.

certification. The act of determining, verifying, and attesting in writing to the qualification of personnel in accordance with specified requirements.

competency. A set of skills, related knowledge, and attributes that allow an individual to perform a task, and that can be verified by performance and/or practical knowledge testing.

Level I—Entry Welder. An individual employed in this position is considered to possess a prerequisite amount of knowledge, attitude, skills, and habits required to perform routine, predictable, repetitive, and procedural tasks involving motor skills, and limited theoretical knowledge while working under close supervison.

Level II—Advanced Welder. An individual employed in this position is considered to possess a prerequisite amount of knowledge, attitude, skills, and habits required to perform proceduralized tasks under general supervision, and complex tasks involving the use of theoretical knowledge and motor skills under close supervision.

module. The collection of training or learning activities defining a particular set of skills for a subject or group of related subjects. A module may contain one or more units. There are compulsory modules and optional modules in both SENSE Level I and Level II programs.

inspection. Examination or measurement to verify whether an item or activity conforms to specified requirements.

performance qualification test. A welding performance test made to the prescribed SWPS or WPS and that requires both visual examination and destructive testing.

Standard Welding Procedure Specification (SWPS). A welding procedure specification qualified according to the requirements of AWS B2.1/B2.1M, approved by AWS, and made available for production welding by companies or individuals other than those performing the qualification test.

unit. The collection of training or learning activities defining a particular set of skills for a single subject. A part of a module that focusses on a particular theme or topic. For example, Module 8, “Thermal Cutting Processes” contains 4 units.

verification. The act of reviewing, inspecting, testing, checking, auditing or otherwise determining and documenting whether items, processes, services, and documents conform to specified requirements.

Welding Procedure Specification (WPS). A document providing the required welding variables for a specific application to assure repeatability by properly trained welders and welder operators.

workmanship qualification test. A welding performance test made to the prescribed SWPS or WPS and that requires visual examination only.

4. Requirements for Level I—Entry Welder

4.1 The trainee must be enrolled in and attending a SENSE Accredited Training Program.

4.2 Partial Completion. In order to qualify for partial completion status, the trainee shall successfully complete all compulsory modules and at least one optional welding process module (SMAW, GMAW, FCAW, and/or GTAW).

4.2.1 The trainee with partial completion status may continue in the program during employment with a signed agreement between the training organization and the trainee's employer stating how the trainee will continue in the program. (See Clause 11 for length of registration.)

4.3 Full Completion. In order to qualify for full completion status as an AWS SENSE Entry Welder, the trainee shall successfully complete the compulsory modules and all welding process modules (SMAW, GMAW, FCAW, and GTAW).

4.4 The trainee must pass the relevant knowledge exams and workmanship or performance qualification tests as specified in Clauses 6 and 7.

4.5 Test results shall be recorded as specified in Clauses 9 and 10.

5. SENSE Guidelines

5.1 SENSE standards provide the training organization with specifications and guidelines for implementing a welder training program based on best practices. SENSE guidelines define the essential knowledge and skills that should be taught in a welding program. Originally, training was conducted at three levels. In this new revision, training has been modularized, and condensed into two levels:

(1) Level I—Entry Welder

(2) Level II—Advanced Welder

5.2 Welder performance qualification tests previously offered in Level III—Expert Welder, are now offered as endorsements to Level II—Advanced Welder.

5.3 Level I—Entry Welder. The recommended guidelines for use with Level I—Entry Welder are found in AWS EG2.0, *Guide for the Training of Welding Personnel: SENSE Level I—Entry Welders*.

5.4 Level II—Advanced Welder. The recommended guidelines for use with the Level II—Advanced Welder program are found in AWS EG3.0, *Guide for the Training of Welding Personnel: SENSE Level II—Advanced Welders*.

5.5 SENSE guidelines do not constitute a curriculum. The AWS SENSE EG2.0 and EG3.0 guidelines are intended to support the development or selection of a SENSE-based curriculum suited to the capabilities of the training organization and tailored to the needs of local employers. The development or selection of curriculum materials is the responsibility of each training organization.

6. Practical Knowledge Exams

6.1 The practical knowledge exams for the modules listed in Table 6.1 are designed to show that trainees understand the subject matter presented in the program. If the trainee has special needs for learning, the instructor shall administer the knowledge exams in the manner most suitable for the trainee.

6.1.1 A safety exam based on ANSI Z49.1, Table 6.1 Module 2 shall be administered prior to skill training. Trainees must achieve a minimum score of 100% on the safety exam before proceeding with skill training.

6.1.2 It is recommended that practical knowledge exams be administered at the completion of each module of training. Alternatively, exams may be administered at other intervals at the discretion of the instructor and the training organization. A minimum score of 75% is required to pass practical knowledge exams.

Table 6.1
Level I—Entry Welder Program Structure

		Verification—Qualification Test			
Learning Module or Unit	Competency	Written	Visual	Destructive	Competency Achieved by:
Module 1	Occupational Orientation	N/A	N/A	N/A	Instructor/Advisor observation
Module 2	Safety and Health of Welders	Yes	N/A	N/A	Written Test Score 100% minimum
Module 3	Drawing and Welding Symbol Interpretation	Yes	N/A	N/A	Written Test Score 75% minimum
Module 4	Shielded Metal Arc Welding (SMAW)	Yes	Yes	Yes	Written Test Score 75% minimum Visual Inspection Passed Destructive Test Passed
Module 5	Gas Metal Arc Welding (GMAW, GMAW-S)	Yes	Yes	N/A	Written Test Score 75% minimum Visual Inspection Passed
Module 6	Flux Cored Arc Welding (FCAW-G/GM, FCAW-S)	Yes	Yes	N/A	Written Test Score 75% minimum Visual Inspection Passed
Module 7	Gas Tungsten Arc Welding (GTAW)	Yes	Yes	N/A	Written Test Score 75% minimum Visual Inspection Passed
Module 8	Thermal Cutting Processes	Yes	N/A	N/A	Written Test Score 75% minimum Visual (see below)
Unit 1	Manual Oxyfuel Gas Cutting (OFC)	Yes	Yes	N/A	Included in Module 8 Test
Unit 2	Mechanized Oxyfuel Gas Cutting (OFC)	Yes	Optional	N/A	Included in Module 8 Test
Unit 3	Manual Plasma Arc Cutting (PAC)	Yes	Yes	N/A	Included in Module 8 Test Visual Inspection Passed
Unit 4	Manual Air Carbon Arc Cutting (CAC-A)	Yes	Optional	N/A	Included in Module 8 Test
Module 9	Welding Inspection and Testing	Yes	N/A	N/A	Written Test Score 75% minimum

N/A = Not applicable.

6.1.3 In order to be registered with partial completion status in the AWS SENSE Certificate Database, the trainee shall successfully complete the knowledge exams for all compulsory modules, and at least one of the optional welding process modules.

Compulsory Modules

Modules 2—Safety and Health of Welders

Modules 3—Drawing and Welding Symbol Interpretation

Modules 8—Thermal Cutting Processes (all units)

Modules 9—Welding Inspection and Testing

Optional Modules

Module 4—Shielded Metal Arc Welding

Module 5—Gas Metal Arc Welding

Module 6—Flux Cored Arc Welding

Module 7—Gas Tungsten Arc Welding

6.1.4 In order to be registered with full completion status in the AWS SENSE Certificate Database, the trainee must successfully complete the practical knowledge exams for all compulsory and optional modules listed in 6.1.3.

6.1.5 Trainees seeking partial or full completion are required to complete the entire Thermal Cutting Processes knowledge exam (Module 8) covering all four (4) units, even if they do not take the hands-on portions of Mechanized OFC (Unit 2) and CAC-A (Unit 4).

6.1.6 Trainees shall be allowed up to three (3) attempts to pass a knowledge exam. If a trainee fails to achieve a passing grade after three (3) attempts, they shall be retrained in that area.

6.1.7 In addition to successfully completing the necessary compulsory and optional module knowledge exams, trainees must complete the workmanship and/or performance qualification tests as specified in Clause 7.

7. Workmanship & Welder Performance Qualification Tests

7.1 In addition to the knowledge exams specified in 6.1.3, the trainee seeking partial completion status as an AWS SENSE Training Certified Entry Welder shall complete the workmanship or performance qualification test(s) associated with the optional welding process module(s), (GMAW, FCAW, GTAW, and/or SMAW), that are included in the individual's course of study.

7.2 In addition to the knowledge exams specified in 6.1.4, the trainee seeking full completion status as an AWS SENSE Entry Welder shall complete the workmanship and performance qualification tests associated with all optional welding process modules, (GMAW, FCAW, GTAW, and SMAW).

7.3 The workmanship and performance qualification tests listed in Table 7.1 are designed to demonstrate that the trainee can:

(1) Read and interpret simple drawings and sketches, including welding symbols.

(2) Follow written procedures.

(3) Cut parts to proper size and fit simple workmanship assemblies.

(4) Pass GMAW workmanship qualification tests (visual examination) using Test 1—GMAW-S (Short Circuiting Transfer) per drawing AWS EDU-3 and Test 2—GMAW (Spray Transfer) per drawing AWS EDU-2 on carbon steel.

(5) Pass FCAW workmanship performance qualification tests (visual examination) using Test 3—FCAW-G/GM (gas shielded) and Test 4—FCAW-S (self-shielded) per drawing AWS EDU-1 on carbon steel.

Table 7.1
Level I—Entry Welder Workmanship and Qualification Tests

Test	Drawing AWS EDU-	Process	Workmanship or Welder Performance	Material	SWPS[a]
1	3	GMAW-S	Workmanship	Steel	B2.1-1-004
2	2	GMAW-Spray	Workmanship	Steel	B2.1-1-235
3	1	FCAW-G	Workmanship	Steel	B2.1-1-019 or B2.1-1-020
4	1	FCAW-S	Workmanship	Steel	B2.1-1-027 or B2.1-1-018
5	3	GTAW	Workmanship	Steel	B2.1-1-008
6	4	GTAW	Workmanship	Stainless	B2.1-8-009
7	5	GTAW	Workmanship	Aluminum	B2.1-1-015
8	6	SMAW	Welder	Steel	B2.1-1-016
9	6	SMAW	Welder	Steel	B2.1-1-016

[a] Any applicable qualified WPS may be used in lieu of SWPS; such as AWS 1.1 prequalified, company furnished, etc.

(6) Pass GTAW workmanship performance qualification tests (visual examination) using Test 5 per drawing AWS EDU-3 on carbon steel, Test 6 per drawing AWS EDU-4 on stainless steel, and Test 7 per drawing AWS EDU-5) on aluminum.

(7) Pass standard AWS limited thickness SMAW welder performance qualification tests (visual examination and bend testing) using Test 8 in the horizontal (2G) position and Test 9 in the vertical (3G) uphill position per drawing AWS EDU-6 on carbon steel.

7.4 For each qualification test, the Entry Welder shall prepare, by flame or plasma arc cutting, the parts required in drawings AWS EDU-1 through 6.

7.5 For each qualification test, the Entry Welder shall assemble the parts prepared in Clause 7.2, as shown in drawings AWS EDU-1 through 6.

7.6 The Entry Welder shall weld the assemblies using the SWPSs in Table 7.1 and further defined in Annexes C and D. Alternately, any qualified WPS provided by the training organization may be used in lieu of the SWPSs included in the EG2.0 supplement.

7.7 Radiographic examination (RT) may be substituted in lieu of AWS standard guided bend tests for welder performance qualification tests.

8. Inspection, Testing, and Acceptance Criteria

8.1 All cut edges shall be visually examined and the cut surfaces shall meet the criteria of AWS C4.1 Sample 2 with grinding. After inspection, the cut surfaces may be conditioned to bright metal.

8.2 All assemblies shall be visually examined and the welds shall meet the acceptance criteria shown in Table 8.1.

Table 8.1
Visual Examination Criteria for Level I—Entry Welders

The Test Supervisor shall visually examine the weld for acceptable appearance, and shall be satisfied that the welder is skilled in using the process and procedure specified for the test.Acceptance criteria shall be as following:
1. No cracks or incomplete fusion.
2. No incomplete joint penetration in groove welds except where partial penetration groove welds are specified.
3. Undercut depth shall not exceed the lesser of 10% of the base metal thickness or 1/32 in (0.8 mm).
4. Face reinforcement or root reinforcement shall not exceed 1/8 in (3 mm).
5. No single pore shall exceed 3/32 in (2 mm).
6. Where visual examination is the only criterion for acceptance, all weld passes are subject to visual examination, at the discretion of the Test Supervisor.

8.3 Face- and root-bend specimens shall be conditioned as shown in Figure 8.1, and bent in a bend fixture similar to Figure 8.2 or 8.3 (guided bend test) or Figure 8.4 (wrap-around bend test) in accordance with AWS B4.0, *Standard Methods for Mechanical Testing of Welds*.

8.4 Face- and root-bend specimens after bending shall meet the acceptance criteria listed in Table 8.2.

9. Documentation

Training organizations shall be a SENSE Accredited Training Program (ATP) organization per AWS QC21, *Specification for AWS Accreditation of SENSE Welder Training Programs*, to be eligible to list full and partial completers in the AWS SENSE Certificate Database.

9.1 Quality Manual. The ATP shall maintain and follow a quality manual that assures compliance with this specification and AWS SENSE QC21, *Specification for AWS Accreditation of SENSE Welder Training Programs*.

9.2 Full Completion of SENSE Level I—Entry Welder Program

9.2.1 In order for a trainee to be registered in the AWS SENSE Certificate Database, the ATP shall submit the following to the AWS Education Department:

(1) The trainee's name and address.

(2) The actual grades on knowledge exams for compulsory modules, including all units of module 8 (Thermal Cutting Processes), and all optional modules.

(3) The results of the visual examination for each workmanship and performance qualification test.

(4) The results of the destructive test or radiographic examination for each SMAW welder performance qualification test.

9.3 Partial Completion of SENSE Level I—Entry Welder Program

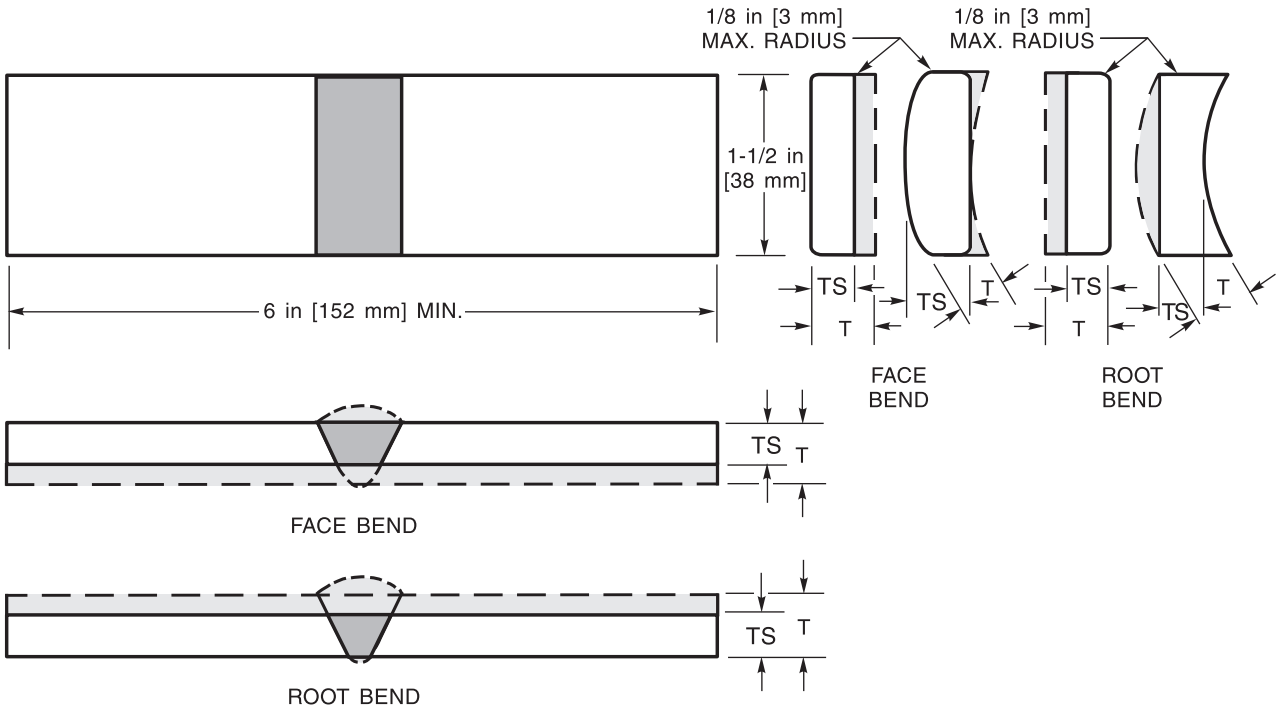
9.3.1 In order for a trainee to be registered in the AWS SENSE Certificate Database, the ATP shall submit the modules completed to the AWS Education Department, along with the following:

(1) The trainee's name and address.

(2) The actual grades on knowledge exams for compulsory modules, including all units of module 8 (Thermal Cutting Processes), and the optional welding process module(s) included in the individual's course of study.

(3) The results of the visual examination for each workmanship and welder performance qualification test(s) for the optional welding process module(s) included in the individual's course of study.

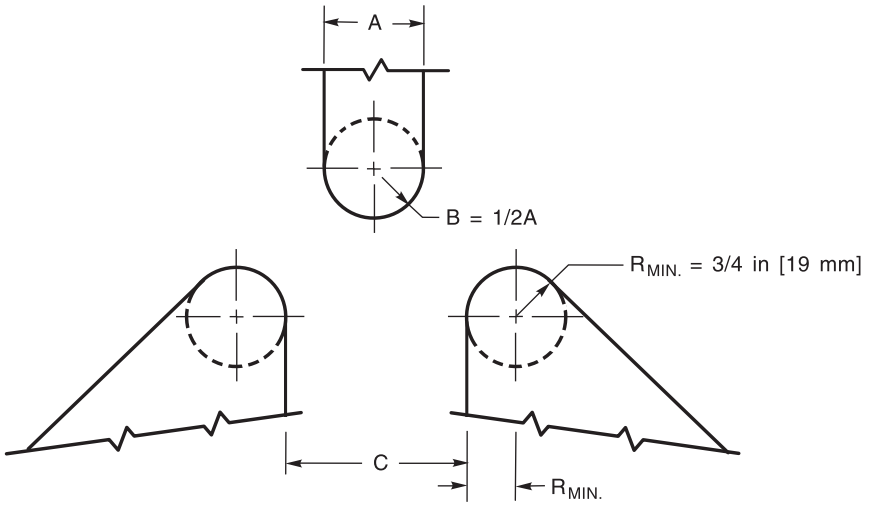
(4) The results of the destructive test or radiographic examination for each SMAW welder performance qualification test, if SMAW is included in the individual's course of study.



INCHES			MILLIMETERS		
	Specimen Thickness (TS)			Specimen Thickness (TS)	
Thickness of Base Materials (T)	All Base Metal Welded with F-23 Filler Metals	All Other Materials	Thickness of Base Materials (T)	All Base Metal Welded with F-23 Filler Metals	All Other Materials
1/16 to 1/8	T	T	1.5 to 3	T	T
1/8 to 3/8	1/8	T	3 to 10	3	T
Over 3/8	1/8	3/8	Over 10	3	10

Notes:
1. Weld reinforcement and backing strip or backing ring, if any, shall be removed flush with the surface of the specimen.
2. If thermal cut, the edges shall be dressed by grinding, except in M-1 materials.
3. For pipe diameters of 2 in through 4 in [51 mm through 102 mm] NPS, the width of the bend specimen may be 3/4 in [19 mm] for pipe diameters of 3/8 in to 2 in [10 mm through 51 mm]. NPS, the bend specimen width may be 3/8 in [10 mm], with an alternative (permitted for pipe 1 NPS in and less) of cutting the pipe into quarter sections, in which case the weld reinforcement may be removed and no other preparation of the specimens is required.

Figure 8.1—Transverse Face and Root Bend Specimens per AWS 2.1

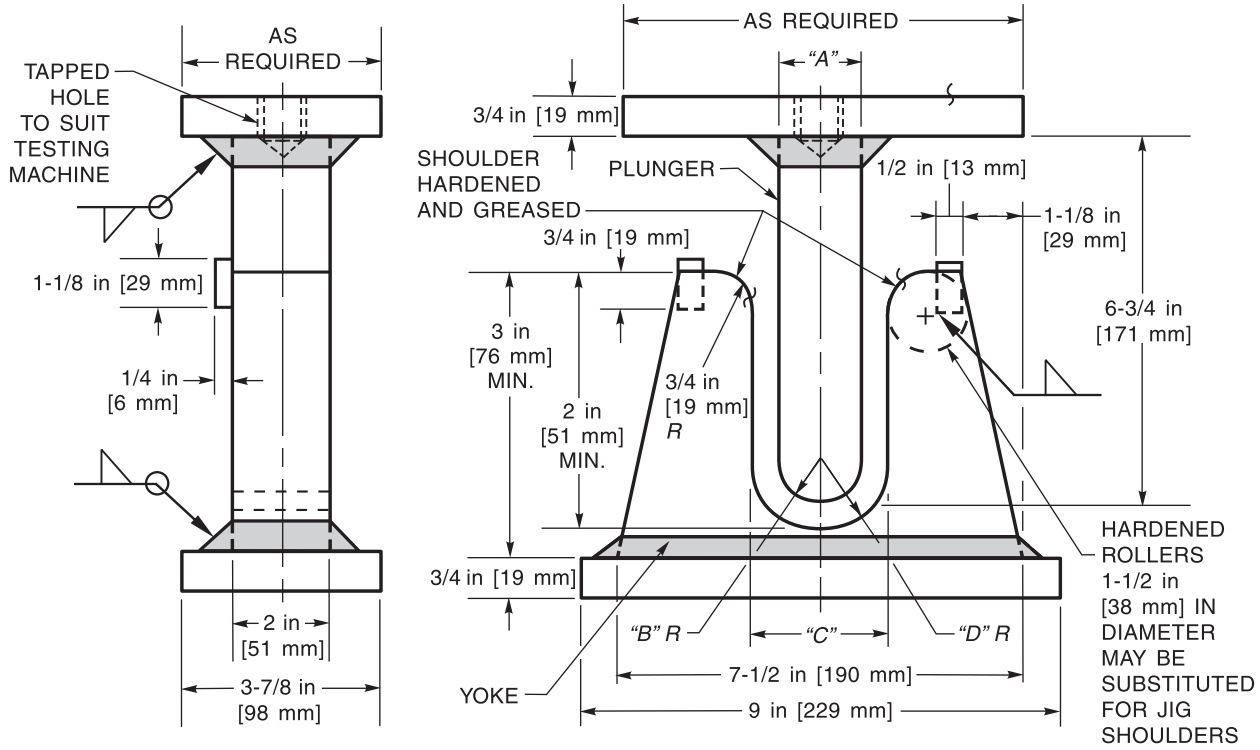


INCHES				MILLIMETERS			
Base Metal[b]	TS[a]	A	C	Base Metal[b]	TS[a]	A	C
M-23 (as welded) M-35 except B148 and B271 All base metals welded with F-23 consumables	<1/8 1/8	(16-1/2)TS 2-1/16	(18-1/2)TS + 1/16 2-3/8	M-23 (as welded) M-35 except B148 and B271 All base metals welded with F-23 consumables	<3 3	(16-1/2)TS 50	(18-1/2)TS + 1-1/2 57
M-11 M-23 (annealed) M-25 M-35, B148, and B271	<3/8 3/8	(6-2/3)TS 2-1/2	(8-2/3)TS + 1/8 3-3/8	M-11 M-23 (annealed) M-25 M-35, B148, and B271	<10 10	(6-2/3)TS 67	(8-2/3)TS + 3 90
M-24 (annealed) M-27, M-61, and M-62	≤3/8	8TS	10TS + 1/8	M-24 (annealed) M-27, M-61, and M-62	≤10	8TS	10TS + 3
M-52 and M-53	≤3/8	10TS	12TS + 1/8	M-52 and M-53	≤10	10TS	12TS + 3
M-54	≤3/8	14TS	16TS + 1/8	M-54	≤10	14TS	16TS + 3
All other M-Number metals	<3/8 3/8	4TS 1-1/2	6TS + 1/8 2-3/8	All other M-Number metals	<10 10	4TS 40	6TS + 3 63

[a] TS = Specimen thickness.
[b] For M-26, M-81, and M-83 materials, two macroetch specimens shall be used in lieu of guided bend testing (see also Figures A.5B and A.5C).

Notes:
1. To calculate the maximum bend diameter for any thickness specimen, use the following formula: A = (100 TS/E) – TS
   Where A = bend diameter, E = minimum tensile elongation, and TS = test specimen thickness.
2. The shoulders of the test figure shall either be hardened rollers free to rotate or hardened and greased fixed shoulder.

Figure 8.2—Guided Bend Fixture—Bottom Ejecting Type per AWS 2.1

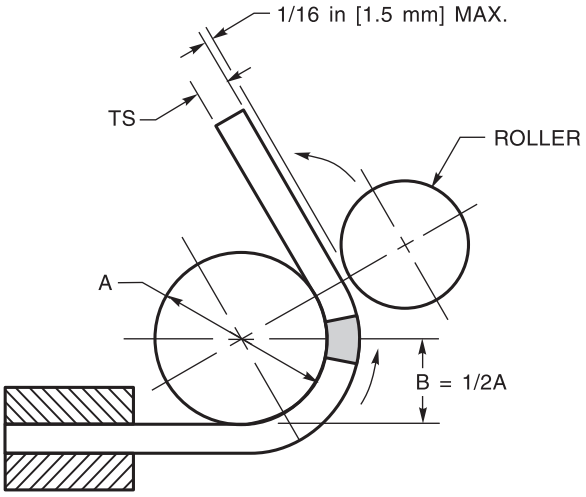


INCHES				MILLIMETERS			
Base Metal[b]	TS[a]	A	C	Base Metal[b]	TS[a]	A	C
M-23 (as welded)				M-23 (as welded)			
M-35 except B148 and B271	<1/8	(16-1/2)TS	(18-1/2)TS + 1/16	M-35 except B148 and B271	<3	(16-1/2)TS	(18-1/2)TS + 1-1/2
All base metals welded with F-23 consumables	1/8	2-1/16	2-3/8	All base metals welded with F-23 consumables	3	50	57
M-11				M-11			
M-23 (annealed)	<3/8	(6-2/3)TS	(8-2/3)TS + 1/8	M-23 (annealed)	<10	(6-2/3)TS	(8-2/3)TS + 3
M-25	3/8	2-1/2	3-3/8	M-25	10	67	90
M-35, B148, and B271				M-35, B148, and B271			
M-24 (annealed)				M-24 (annealed)			
M-27, M-61, and M-62	≤3/8	8TS	10TS + 1/8	M-27, M-61, and M-62	≤10	8TS	10TS + 3
M-52 and M-53	≤3/8	10TS	12TS + 1/8	M-52 and M-53	≤10	10TS	12TS + 3
M-54	≤3/8	14TS	16TS + 1/8	M-54	≤10	14TS	16TS + 3
All other M-Number metals	<3/8	4TS	6TS + 1/8	All other M-Number metals	<10	4TS	6TS + 3
	3/8	1-1/2	2-3/8		10	40	63

[a] TS = Specimen thickness.
[b] For M-26, M-81, and M-83 materials, two macroetch specimens shall be used in lieu of guided bend testing (see also Figures A.5A and A.5C).

Notes:
1. To calculate the maximum bend diameter for any thickness specimen, use the following formula: A = (100 TS/E) – TS
   Where A = bend diameter, E = minimum tensile elongation, and TS = test specimen thickness.
2. The shoulders of the test figure shall either be hardened rollers free to rotate or hardened and greased fixed shoulder.

Figure 8.3—Guided Bend Fixture—Bottom Type per AWS 2.1



INCHES			MILLIMETERS		
Base Metal[b]	TS[a]	A	Base Metal[b]	TS[a]	A
M-23 (as welded) M-35 except B148 and B271 All base metals welded with F-23 consumables	<1/8 1/8	(16-1/2)TS 2-1/16	M-23 (as welded) M-35 except B148 and B271 All base metals welded with F-23 consumables	<3 3	(16-1/2)TS 50
M-11 M-23 (annealed) M-25 M-35, B148, and B271	<3/8 3/8	(6-2/3)TS 2-1/2	M-11 M-23 (annealed) M-25 M-35, B148, and B271	<10 10	(6-2/3)TS 67
M-24 (annealed) M-27, M-61, and M-62	≤3/8	8TS	M-24 (annealed) M-27, M-61, and M-62	≤10	8TS
M-52 and M-53	≤3/8	10TS	M-52 and M-53	≤10	10TS
M-54	≤3/8	14TS	M-54	≤10	14TS
All other M-Number metals	<3/8 3/8	4TS 1-1/2	All other M-Number metals	<10 10	4TS 40

[a] TS = Specimen thickness.
[b] For M-26, M-81, and M-83 materials, two macroetch specimens shall be used in lieu of guided bend testing (see also Figures A.5A and A.5B.

Notes:
1. To calculate the maximum bend diameter for any thickness specimen, use the following formula: A = (100 TS/E) – TS
   Where A = bend diameter, E = minimum tensile elongation, and TS = test specimen thickness.
2. The shoulders of the test figure shall either be hardened rollers free to rotate or hardened and greased fixed shoulder.

Figure 8.4—Guided Bend Fixture—Wrap-Around per AWS 2.1

Table 8.2
Acceptance Criteria for Face- and Root-Bends

For acceptance, the convex surface of the face- and root-bend specimens shall meet both of the following requirements:
1. No single indication shall exceed 1/8 in (3.2 mm), measured in any direction on the surface.
2. The sum of the greatest dimensions of all indications on the surface, which exceed 1/32 in (0.8 mm), but are less than or equal to 1/8 in (3.2 mm), shall not exceed 3/8 in (9.6 mm).
Cracks occurring at the corner of the specimens shall not be considered unless there is definite evidence that they result from slag inclusions or other internal discontinuities.

10. Records of Welder Training Certificate

10.1 The ATP shall submit the trainee's records for full or partial program completion to the AWS Education Department, along with the appropriate fee.

10.2 The individual will be placed in the AWS SENSE Certificate Database.

10.3 In recognition of successful full or partial completion, AWS will issue a SENSE certificate and wallet card to the individual listing the modules and tests completed.

11. Registration of Entry Welders

11.1 AWS shall maintain records of completion for 3 years.

11.2 Individuals registered in the AWS SENSE Certificate Database are not required to maintain a training certificate by reporting welding activities.

11.3 An individual with full completion status shall remain active as a Level I—Entry Welder in the AWS SENSE Certificate Database for three (3) years, after which time a permanent record shall be archived.

11.4 An individual with partial completion status shall remain active in the AWS SENSE Training Certified Database for three (3) years from the date of their last completed arc welding process competency, after which time a permanent record shall be archived.

11.5 If an individual with partial completion status completes the entire Level I—Entry Welder program during the three (3) year active period, the training organization will verify full completion by submitting the records to AWS. The trainee will be listed as an AWS SENSE Entry Welder for three (3) years from the date of program completion, after which time a permanent record shall be archived.

12. AWS SENSE Accredited Training Program Accreditation

AWS SENSE Accredited Training Program accreditation is available to all career technical institutions, colleges and other training organizations that can meet the requirements of AWS QC21, *Specification for AWS Accreditation of SENSE Welder Training Programs.* To learn more about the accreditation process and the benefits associated with becoming an AWS SENSE Accredited Training Program visit www.aws.org/education.

Annex A (Normative)

Visual Examination Results

This annex is part of this standard and includes mandatory elements for use with this standard.

Name of Student _____

Identification No. _____

Sample # _____

Size:

Under ❒ OK ❒ Excessive ❒

Undercut:

Acceptable ❒ Rejected ❒

Porosity:

Diameter of Largest _____

Acceptable ❒ Rejected ❒

Overlap:

Acceptable ❒ Rejected ❒

Penetration:

Acceptable ❒ Rejected ❒

Appearance:

Acceptable ❒ Rejected ❒

Cracks:

Acceptable ❒ Rejected ❒

Name _____ Date _____

(Please Print)

Signature _____

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Annex B (Normative)

Face- and Root-Bend Test Results

This annex is part of this standard and includes mandatory elements for use with this standard.

Name of Student _____

Identification No. _____

Sample # _____

Face-bend:

Length of each discontinuity (Over 1/32 in.) _____ _____ _____ _____ Sum _____

Accept ❒ Reject ❒

Root-bend:

Length of each discontinuity (Over 1/32 in.) _____ _____ _____ _____ Sum _____

Accept ❒ Reject ❒

Name _____ Date _____

(Please Print)

Signature _____

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Annex C (Normative)

Standard Welding Procedure Specifications for Level I Welding Performance Qualification Tests

This annex is part of this standard and includes mandatory elements for use with this standard.

C.1 Scope

SENSE Level I workmanship and welder performance qualification tests shall be conducted using AWS B2 SWPSs or alternative WPSs, as described in AWS QC10, *Specification for Qualification and Certification of SENSE Level I—Entry Welders.* AWS SWPSs are provided in AWS EG2.0 Supplement, *Supplement SENSE Level I—Entry Welder Training Performance Testing Procedures* for educational use only.

Table C.1 shows which SWPS is recommended (based on availability) for the workmanship or welder performance qualification test drawings in QC10. Additional SWPSs may be recommended in the future for use in the EG2.0 Supplement as they are qualified by the B2 Committee.

Training organizations have the option to use other governing standards and WPSs that are qualified to AWS D1 Structural Welding Codes, or other national or international standards. It is the responsibility of the training organization to specify the appropriate SWPSs, alternate WPSs, and governing standard(s).

Table C.1
Recommended SWPSs for Level I Tests

Test	Process/Material	SWPS	Drawing AWS EDU-
1	GMAW-S/Steel	B2.1-1-004	3
2	GMAW (Spray)/Steel	B2.1-1-235	2
3	FCAW-G/Steel	B2.1-1-019 or B2.1-1-020	1
4	FCAW-S/Steel	B2.1-1-027 or B2.1-1-018	1
5	GTAW/Steel	B2.1-1-008	3 1
6	GTAW/Stainless	B2.1-8-009	4 1
7	GTAW/Aluminum	B2.1-1-015	5 3
8	SMAW/Steel	B2.1-1-016	6 4
9	SMAW/Steel	B2.1-1-016	6 5

C.2 SWPS Reference Documents

Unless specified, the latest approved revision of the SWPS applies for the recommended SENSE Level I Welding Performance Qualification test. See Table C.2

Table C.2
SWPS Reference Documents

Test No.	AWS SWPS	Title
Test 1	B2.1-1-004	*Standard Welding Procedure Specification (SWPS) for Gas Metal Arc Welding (Short Circuiting Transfer Mode) of Carbon Steel (M-1, Group 1), 18 through 10 gauge, As-Welded Condition, with or without Backing*
Test 2	B2.1-1-235	*Standard Welding Procedure Specification (SWPS) for Argon plus 2% Oxygen Shielded Gas Metal Arc Welding (Spray Transfer Mode) of Carbon Steel (M-1/P-1/S-1, Groups 1 and 2), 1/8 through 1-1/2 inch Thick, ER70S-3, Flat Position Only, As-Welded or PWHT Condition, Primarily Pipe Applications*
Test 3	B2.1-1-019	*Standard Welding Procedure Specification (SWPS) for CO_2 Shielded Flux Cored Arc Welding of Carbon Steel (M-1/P-1, Group 1 or 2), 1/8 through 1-1/2 inch Thick, E70T-1 and E71T-1, As-Welded Condition; or B2.1-1-020, Standard Welding Procedure Specification (SWPS) for 75% Ar/25% CO_2 Shielded Flux Cored Arc Welding of Carbon Steel (M-1/P-1, Group 1 or 2), 1/8 through 1-1/2 inch Thick, E70T-1 and E71T-1, As-Welded or PWHT Condition*
Test 4	B2.1-1-027	*Standard Welding Procedure Specification (SWPS) for Self-Shielded Flux Cored Arc Welding of Carbon Steel (M-1/P-1/S-1, Group 1 or 2), 1/8 through 1/2 inch Thick, E71T-11, As-Welded Condition; or B2.1-1-018, Standard Welding Procedure Specification (SWPS) for Self-Shielded Flux Cored Arc Welding of Carbon Steel (M-1/P-1/S-1, Group 1 or 2), 1/8 through 1-1/2 inch Thick, E71T-8, As-Welded Condition*
Test 5	B2.1-1-008	*Standard Welding Procedure Specification (SWPS) for Gas Tungsten Arc Welding of Carbon Steel (M-1/P-1 or S-1), 18 through 10 gauge, As-Welded Condition, with or without Backing*
Test 6	B2.1-8-009	*Standard Welding Procedure Specification (SWPS) for Gas Tungsten Arc Welding of Austenitic Stainless Steel (M-8/P-8 or S-8), 18 through 10 gauge, As-Welded Condition, with or without Backing*
Test 7	B2.1-22-015	*Standard Welding Procedure Specification (SWPS) for Gas Tungsten Arc Welding of Aluminum (M-22/P-22 or S-22), 18 through 10 gauge, As-Welded Condition, with or without Backing*
Test 8 & 9	B2.1-1-016	*Standard Welding Procedure Specification (SWPS) for Shielded Metal Arc Welding of Carbon Steel (M-1/P-1/S-1, Group 1 or 2), 1/8 through 1-1/2 inch Thick, E7018, As-Welded or PWHT Condition*

Annex D (Informative)
Level I Welding Performance Qualification Matrix

This annex is not part of this standard but is included for informational purposes only.

Table D.1 provides a summary of Level I Workmanship and Welder Performance Qualification tests and recommended Standard Welding Procedure Specification (SWPS) where applicable.

Table D.1
Recommended SWPS for SENSE Level I Module Performance Qualification Tests

Test	Drawing AWS EDU No.	Process	Workmanship/ Performance	Material	Position	Test Thickness (in.)	SWPS[a]	SWPS Qual. Thickness (in.)
1	3	GMAW-S	Workmanship	Steel	Multiple	10 ga.–14 ga.	B2.1-1-004	10 ga.–18 ga.
2	2	GMAW-Spray	Workmanship	Steel	2G, 1F	0.375	B2.1-1-235	1/8–1.5
3	1	FCAW-G	Workmanship	Steel	Multiple	0.375	B2.1-1-019 or B2.1-1-020	1/8–1/2 or 1.5
4	1	FCAW-S	Workmanship	Steel	Multiple	0.375	B2.1-1-027 or B2.1-1-018	1/8–1.5
5	3	GTAW	Workmanship	Steel	Multiple	10 ga.–14 ga.	B2.1-1-008	10–8 ga.
6	4	GTAW	Workmanship	Stainless	Multiple	10 ga.–14 ga.	B2.1-8-009	10–8 ga.
7	5	GTAW	Workmanship	Aluminum	1G, 2F	10 ga.–14 ga.	B2.1-1-015	10 –8 ga.
8	6	SMAW	Performance	Steel	2G	0.375	B2.1-1-016	1/8–1.5
9	6	SMAW	Performance	Steel	3G	0.375	B2.1-1-016	1/8–1.5

[a] Any applicable qualified WPS may be used in lieu of SWPS (AWS 1.1 prequalified, company furnished, etc.).

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Annex E (Informative)

Guidelines for the Preparation of Technical Inquiries for the AWS Education Committees

This annex is not part of this standard but is included for informational purposes only.

E1. Introduction

The American Welding Society (AWS) Board of Directors has adopted a policy whereby all official interpretations of AWS standards are handled in a formal manner. Under this policy, all interpretations are made by the committee that is responsible for the standard. Official communication concerning an interpretation is directed through the AWS staff member who works with that committee. The policy requires that all requests for an interpretation be submitted in writing. Such requests will be handled as expeditiously as possible, but due to the complexity of the work and the procedures that must be followed, some interpretations may require considerable time.

E2. Procedure

All inquiries shall be directed to:

Director, Education Services Department
American Welding Society
8669 NW 36 St, # 130
Miami, FL 33166

All inquiries shall contain the name, address, and affiliation of the inquirer, and they shall provide enough information for the committee/subcommittee to understand the point of concern in the inquiry. When the point is not clearly defined, the inquiry will be returned for clarification. For efficient handling, all inquiries should be typewritten and in the format specified below.

E2.1 Scope. Each inquiry shall address one single provision of the specification, unless the point of the inquiry involves two or more interrelated provisions. The provision(s) shall be identified in the scope of the inquiry, along with the edition of the specification that contains the provision(s) the inquirer is addressing.

E2.2 Purpose of the Inquiry. The purpose of the inquiry shall be stated in this portion of the inquiry. The purpose can be either to obtain an interpretation of a specification's requirement, or to request the revision of a particular provision in the specification.

E2.3 Content of the Inquiry. The inquiry should be concise, yet complete, to enable the committee to quickly and fully understand the point of the inquiry. Sketches should be used when appropriate and all paragraphs, figures, and tables (or the Annex), which bear on the inquiry shall be cited. If the point of the inquiry is to obtain a revision of the specification, the inquiry must provide technical justification for that revision.

E2.4 Proposed Reply. The inquirer should, as a proposed reply, state an interpretation of the provision that is the point of the inquiry, or the wording for a proposed revision, if that is what the inquirer seeks.

E3. Interpretation of Provisions

Interpretations of specification provisions are made by the Education Committee. The secretary of the committee refers all inquiries to the chair of the particular subcommittee that has jurisdiction over the particular specification addressed by the inquiry. The subcommittee reviews the inquiry and the proposed reply to determine what the response to the inquiry should be. Following the development of the response, the inquiry and the response are presented to the entire Education Committee for review and approval. Upon approval by the committee, the interpretation is an official interpretation of the Society, and the secretary transmits the response to the inquirer and to the Welding Journal for publication.

E4. Publication of Interpretations

All official interpretations shall appear in the *Welding Journal* and will be posted on the AWS web site.

E5. Telephone Inquiries

Telephone inquiries to AWS Headquarters concerning the AWS QC10, *Specification for Qualification and Certification of SENSE Level I—Entry Welders*, should be limited to matters directly related to the use of the specification. The AWS Board of Directors' policy requires that all AWS staff members respond to a telephone request for an official interpretation of any AWS standard with the information that such an interpretation can be obtained only through a written request.

E6. The Education Committee

The activities of the Education Committee regarding interpretations are limited strictly to the interpretation of specification provisions or to consideration of revisions to existing provisions. Neither AWS staff nor the committees are in a position to offer interpretive or consulting services on: (1) specific engineering problems, or (2) requirements that apply to topics outside the scope of the specification or points not specifically covered by the specification. In such cases, the inquirer should seek assistance from a competent engineer or consultant experienced in the particular field of interest.